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ON THE DINOSAURS OF THE MAASTRICHT BEDS.

On the Dinosaurs *from the* Maastricht Beds. By H. G. Seeley, Esq., F.R.S., F.G.S., &c., Professor of Geography in King's College, London.

In 1871 the Geological Department of the British Museum acquired the celebrated collection formed by Professor van Breda at Haarlem. It was especially rich in the remains of fossil reptiles from Maastricht; and among the bones of *Mosasaurus* were arranged five other specimens, which Mr. William Davies, F.G.S., soon recognized as Dinosaurian. So far as is at present known, these are the most recent evidences of the Dinosaurian order in geological time; and in view of this fact, I am happy in having the permission of Dr. Henry Woodward, F.R.S., the Keeper of the Department, to offer the Geological Society some account of the structure of the last known survivors of the group. I avail myself the more readily of this permission, since I do not remember to have seen in any of the continental museums other specimens exhibited which would add materially to the British-Museum evidence or modify my conclusions.

These five bones belong to two types. One femur is Megalosaurian; and although it is quite possible that other parts of the skeleton may enable their discoverer to refer the animal to a new genus, I have not felt justified in differentiating the genus from *Megalosaurus* on the evidence of one bone, imperfect distally, and with the proximal end worn. The other specimens are Iguanodont. I have referred them to an Iguanodont genus *Orthomerus*; and I have no doubt that the remainder of the skeleton will eventually show them to belong to a new generic type. For more certain reference, I give the British-Museum numbers on the specimens.

Megalosaurus Bredai, Seeley.

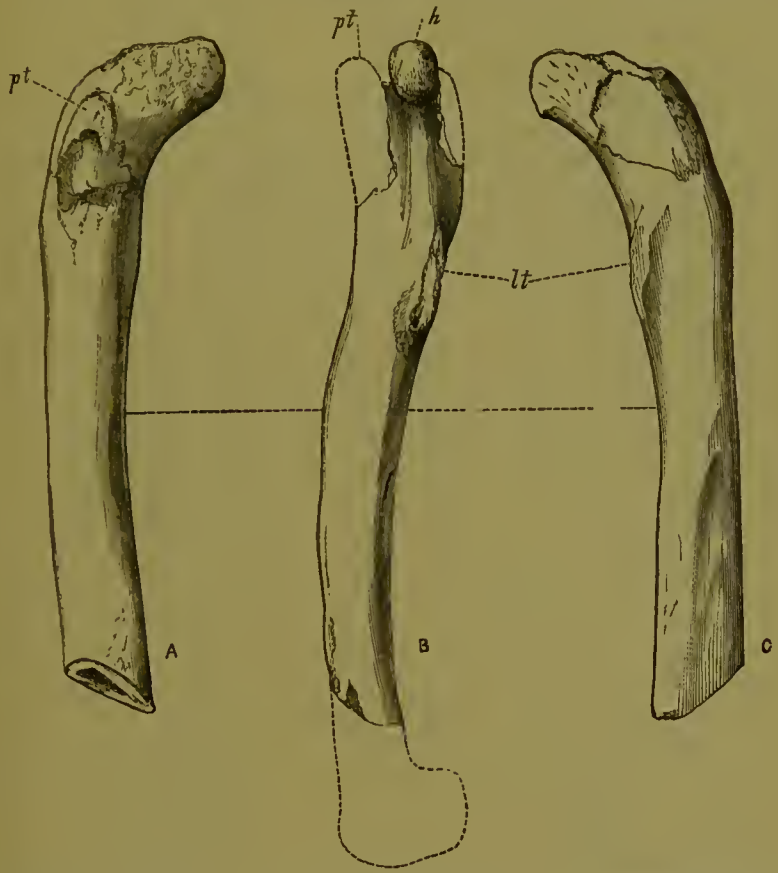
No. 42997. This right femur is of Megalosaurian type.

The bone is very imperfect; the distal end has been sawn away (fig. 1, A), so that the bone shows no indication of the distal articulation, though some changes in the form of the shaft suggest that no large portion is lost (fig. 1, B). The proximal end is a good deal worn and broken away (fig. 1, B); but enough remains to demonstrate its more remarkable characters.

The femur, as a whole, is remarkable for its slender form, its superior bow-shape curvature, the lateral compression of the proximal articulation (fig. 1, B, *h*), and the extent to which it is directed inward, for the proximal trochanter, which is separated from the proximal end of the bone in front (fig. 1, A, *p t*), and for the proximal position and small size of the lateral trochanter (fig. 1, B and C, *l t*).

The fragment, as preserved, is nearly 29 cm. ($11\frac{2}{5}$ in.) long. The shaft of the bone is unusually compressed from side to side, so as to make the vertical thickness (fig. 1, B) as much as or more than the width (fig. 1, A); and while the surfaces of the bone generally are rounded, the superior or anterior aspect is marked by a blunt ridge

Fig. 1.—*Right femur of* Mogalosaurus Bredai. ($\frac{1}{4}$ nat. size.)



A. Anterior aspect. B. Inner aspect. C. Posterior aspect.
h, articular head ; *p t*, proximal trochanter restored ; *l t*, lateral trochanter.

which becomes more angular as it ascends towards the proximal trochanter; but the ridge does not diverge outward much from the median line. At 7 cm. ($2\frac{3}{4}$ in.) from the proximal end the bone is 41 mm. ($1\frac{2}{3}$ in.) thick and 39 mm. ($1\frac{4}{7}$ in.) wide. At 13 cm. ($5\frac{1}{8}$ in.) from the proximal end the thickness is 35 mm. ($1\frac{2}{5}$ in.), and the width 32 mm. ($1\frac{1}{3}$ in.). At the distal end the bone becomes more flattened, and widens a little; the thickness is 28 mm. ($1\frac{1}{8}$ in.), and the width 38 mm. ($1\frac{1}{2}$ in.); the increase in distal width is chiefly a widening on the inner side, which becomes vertical. The external margin, though slightly concave, is nearly straight; viewed from the outside it has an aspect proximally of broad inflation, which becomes much reduced towards the distal end, chiefly owing to the increasing convexity of the inferior or posterior surface. But there is a slight elevation at about 8 cm. ($3\frac{1}{7}$ in.) from the proximal end; and the external surface curves inward from this point as it extends proximally, forming a sharp angle with the distal part of the external margin. The posterior surface in its distal half has a median longitudinal rounded ridge which fades away distally, and inclines a t t le towards the inner side of the bone.

The lateral trochanter (*l t*, figs. B and C) is rather less than 5 cm. (2 in.) long, tapers proximally and distally, is compressed from above and below, and shows on the anterior side a small muscular scar, which deepens towards the distal border. The trochanter extends within about $7\frac{1}{2}$ cm. (3 in.) of the proximal end: it is directed a little inward and backward. At the upper limit of the trochanter the shaft is approximately triangular, being flattened below, while the inner and outer sides converge to the median anterior ridge.

The head of the bone (*h*, fig. B) has the aspect of being bent inward, the external outline being strikingly convex, and the inner border concave, so that the transverse width of the head, as preserved, is not more than $6\frac{1}{2}$ cm. ($2\frac{2}{7}$ in.). Externally and superiorly there was a trochanter, which formed an angular ridge; it was divided from the head of the bone by a vertical groove, but must have been short, since the bone could not have extended more than from 1 to 2 cm. proximally beyond the base of the groove which proves its existence. Internal to this trochanteric ridge the bone is compressed and concave. As preserved, the articular head of the bone is 2 cm. ($\frac{4}{5}$ in.) thick, and less than 3 cm. ($1\frac{1}{5}$ in.) deep; but it is abraded, and there is no trace left of articular surface, or of the proximal cartilaginous tissue of the bone, which from within outward did not measure more than 6 cm. ($2\frac{4}{11}$ in.), and now measures rather less; the posterior surface behind the articular head is somewhat inflated, so as to make the transverse section semicircular. Seen from the inner side the head of the bone is inclined towards the inner trochanter, so that it has a slightly oblique appearance as to its vertical direction (fig. B); but it is almost at right angles to the external surface of the shaft.

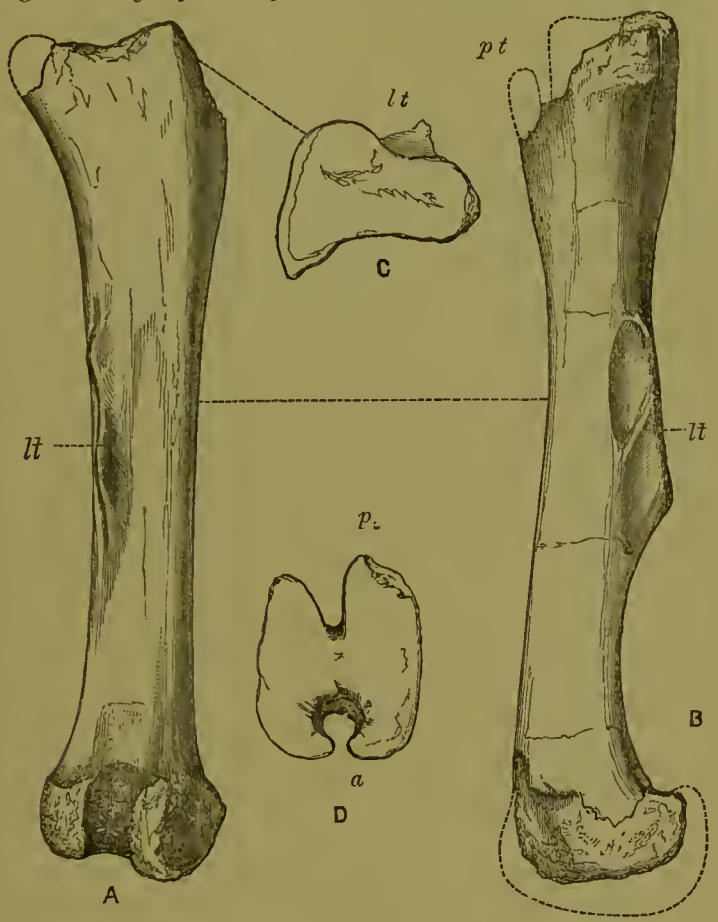
The differences of this bone from the femur of *Megalosaurus Bucklandi* extend to almost every detail: first, the distal end of the bone is compressed from front to back, while in *Bucklandi* it thickens; the lateral internal trochanter is much more proximal in position; the external trochanter is much much closer to the head of the bone in this specimen, and more proximal in position; the curvature of the shaft is relatively greater, and its antero-posterior thickness is greater.

ORTHOMERUS DOLLOI, Seeley.

No. 42955. A large femur (fig. 2), which is slightly imperfect at its articular ends, measures $49\frac{1}{2}$ cm. ($19\frac{1}{2}$ in.) in length. The shaft is remarkably straight and strong. The bone is subtriangular at the proximal end, is subquadrate but wider than thick in the lower part of the shaft, and has the lateral trochanter in the middle of the shaft, with the proximal and distal ends modified on the Iguanodont plan.

The distal end of the femur is fractured in front (fig. 2, B), where the condylar portion was probably a little expanded anteriorly, as in a second and smaller specimen (fig. 2, D). Across the condyles of the type the measurement is fully 10 cm. (4 in.). The posterior inner condyle is considerably the larger; and the two are divided by a deep concave channel (fig. 2, A). The external or anterior distal condyles were similarly divided by a concavity, so that the thickness of

Fig. 2.—*Right femur of* Orthomorus Dolloi. ($\frac{1}{5}$ nat. size.)



A. Posterior aspect: *l t*, lateral trochanter.
B. Inner lateral aspect: *p t*, proximal trochanter.
C. Outline of proximal end, reversed.
D. Outline of distal end of another specimen (B. M. No. 42957).
a, anterior, *p*, posterior condyles.

bonedividing the anterior and posterior surfaces on the distal face of the articulation is about 3 cm. ($1\frac{1}{5}$ in.). External to the outer of the posterior condyles is a slight ridge, which is rounded and situate behind the middle of the outer side of the bone, so as to make the shorter posterior area markedly concave and to form a slight concavity anteriorly. This modification, which is limited to the condylar region, has the effect of giving the outer posterior condyle a compressed aspect, and makes the bone compressed posteriorly. Distally there is a moderate concavity between the condyles from within outward; but the articular surface is imperfectly preserved, though the outer condyle appears to have had the greater distal extension. The depth of the inner condyle is about 6 cm. ($2\frac{4}{11}$ in.). The width across the condylar region, as preserved, is 10 cm. (4 in.). The antero-posterior measurement cannot be given. Above the condyles the distal end of

the shaft is concave from side to side posteriorly; the concavity, diminishing in amount, extends proximally towards the region of the lateral trochanter. The width of the shaft just above the condyles is under 9 cm. ($3\frac{4}{7}$ in.); and the median thickness of the shaft is under 5 cm. (2 in.). The two sides of the shaft converge a little towards the base of the lateral trochanter; and the sides converge upward towards the anterior surface so as to give the front of the bone a convex or subcylindrical aspect in its middle third. Distally, towards the condyles the front of the bone is gently concave; but the concavity narrows and deepens rapidly to descend between the anterior expansions of the condyles, which are broken away.

The lateral trochanter and muscular ridge (fig. 2, A, B, *l t*) extends to within 19 cm. ($7\frac{3}{5}$ in.) of the distal end, is nearly 14 cm. ($5\frac{1}{2}$ in.) long, and extends to within about 15 cm. (6 in.) of the proximal end. It is a compressed curved process which is directed mainly backward and a little inward, and is much more developed in its distal half than in the proximal part. It owes its existence to two powerful muscular attachments, which are on the inner side of the bone; they partly overlap each other, so that the proximal scar descends partly in front of the distal impression. The proximal scar is about 8 cm. ($3\frac{1}{7}$ in.) long, and 3 cm. ($1\frac{1}{5}$ in.) wide; less than half of its width is attached to the trochanteric process. The distal scar is quite as long and as wide, but is pointed proximally, rounded distally, is much deeper, and is chiefly attached to the trochanter (fig. 2, B, *l t*). The posterior edge of the trochanter, which is inclined obliquely backward (fig. 2, A), is nearly parallel to the anterior borders of the muscular scars. The width of the shaft just below the trochanter is 6 cm. ($2\frac{4}{11}$ in.); its thickness in the same position is 5 cm. (2 in.).

Proximally, above the trochanter the form of the shaft alters, becoming compressed and well rounded on the inner surface, and greatly widened on the external border, so that the transverse section is subtriangular (fig. 2, C); the anterior surface is broadly concave, with the concavity increasing as the proximal trochanteric ridge is developed externally; the posterior surface is flattened, with a moderate median longitudinal concavity; and the external surface is flattened along its whole extent, but is a little convex from above downward, and has a broad shallow concavity behind the lateral trochanter.

No. 42957. A second specimen is smaller, and worth describing because it shows the form of the distal end (fig. 2, D).

This fragment consists of the shaft and distal end of a Dinosaurian femur of moderate size. The fragment measures 30 cm. ($11\frac{4}{5}$ in.) in length, and extends for about 3 cm. ($1\frac{1}{5}$ in.) beyond the internal lateral trochanter. The shaft is more quadrate in section than in the larger specimen, is more concave on the inner margin, has a slight convexity in length on the external border, and exhibits various minor details of structure.

The width of the shaft just below the lateral trochanter at 13 cm. ($5\frac{1}{8}$ in.) from the distal end is $3\frac{1}{2}$ cm. ($1\frac{2}{5}$ in.); the thickness in the same position is just over 4 cm. ($1\frac{4}{7}$ in.).

The extreme length of the lateral trochanter is $10\frac{1}{2}$ cm. ($4\frac{1}{8}$ in.); it is directed backward only. It is narrow, being compressed from side to side, and is most elevated in the middle, while in the larger specimen the greatest elevation is below the middle. One muscular attachment extends along the whole of its inner border, tapering above and below: while proximally there is a vertically ovate impression, nearly 5 cm. (2 in.) long, which runs side by side with the proximal part of this impression.

The sides of the shaft are remarkably parallel, flattened behind and on the external surface, rounded in front and on the internal surface, though the convexity decreases distally.

On the external surface is a longitudinal median muscular scar about 5 cm. (2 in.) long; it is rugose in the middle, and extends to within about $11\frac{1}{2}$ cm. ($4\frac{1}{2}$ in.) of the distal end.

The outline of the distal end is like the letter H, owing to the way in which the anterior and posterior channels between the condyles cut into the bone (fig. 2, D). The inner condyle, as usual, is much the larger posteriorly (fig. 2, D, *p*), measuring 9 cm. ($3\frac{4}{7}$ in.) from front to back, while the outer condyle is only 8 cm. ($3\frac{1}{7}$ in.) from front to back, and it is much more compressed from side to side, especially proximally.

The transverse measurement over the condyles is $7\frac{1}{2}$ cm. (3 in.). Anteriorly the condyles are deeply channelled by a nearly circular canal (fig. 2, D, *a*) which descends obliquely downwards and backward and expands on the distal surface, so as to be broader than the posterior channel.

The extreme width of the proximal expansion of the bone on the external surface, as preserved at the base of the trochanter, is under 9 cm. ($3\frac{4}{7}$ in.). The trochanteric process is subtriangular; it is broken away, but its base is defined by a narrow groove extending backward.

The proximal articular end is entirely broken away, though slight traces of its deep median concavity remain on the posterior border.

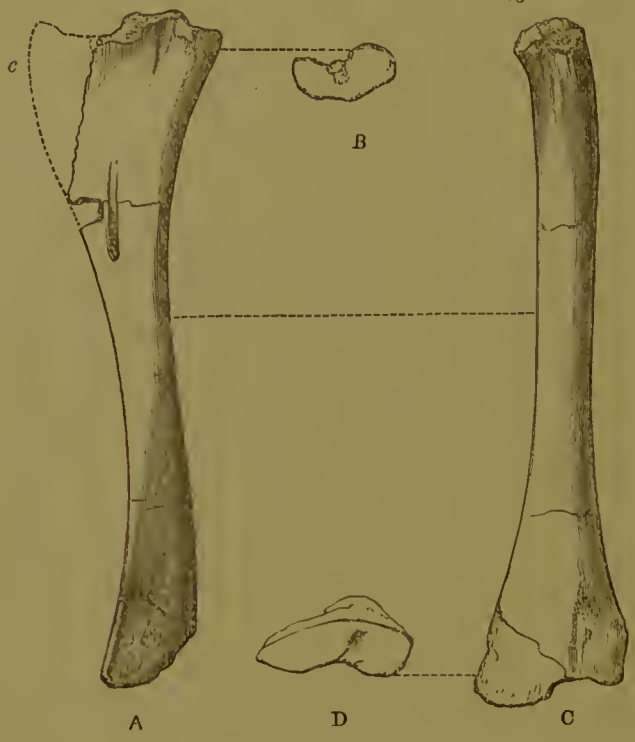
On the external lateral aspect is a large rough surface, which is an ill-defined very shallow muscular attachment. It is about 9 cm. ($3\frac{4}{7}$ in.) long, nearly as broad as the lateral surface, is more distal in position than the lateral trochanter on the opposite inner side of the bone, and extends to within about 17 cm. ($6\frac{7}{10}$ in.) of the distal articular surface.

In the main characters this form of femur closely resembles *Iguanodon*; in nearly all points in which it differs, it approximates to *Hadrosaurus*.

No. 42954. Left Tibia (fig. 3). This is a long slender bone, which exhibits the distinctive characteristics of the tibia, although the articular surfaces are gone from both ends, and the cnemial crest is entirely sawn away (fig. 3, A), so as to give the specimen somewhat the aspect of a slender humerus. The bone, as preserved, is 27 cm. ($10\frac{3}{5}$ in.) long. The proximal end is at right angles to the distal end (fig. 3 c). On the whole the specimen shows the nearest resemblance to *Iguanodon*, but is much more slender, and shows some difference in form.

The distal end (fig. 3, D), as preserved, is under 9 cm. ($3\frac{4}{7}$ in.) wide;

Fig. 3.—*Left tibia of* Orthomerus Dolloi. ($\frac{1}{5}$ nat. size.)



A. Outer lateral aspect: *c*, enemial crest.
B. Outline of proximal end, reversed.
C. Posterior aspect. D. Outline of distal end.

the shaft widens distally in a wedge shape (fig. 3, c), is flattened in front much more than in *Iguanodon*, with a moderate median concavity for the ascending process of the astragalus, which was more than 2 cm. ($\frac{4}{5}$ in.) wide. On the outer border the bone appears to have formed a slight ridge in the distal 5 cm. (2 in.), though the ridge is abraded and lost.

The external fibular area, which in Dinosaurs is usually well defined by a sharp angle, is here ill defined, about 2 cm. ($\frac{4}{5}$ in.) wide, and almost in the same plane with the remainder of the distal end of the bone. The fibular margin is sharp, sharper than in *Iguanodon*, though, from the abrasion of the posterior surface, it appears to be sharper than it really is. The fibular side appears to extend outward more rapidly than the inner side, as usual; but the inner side does not widen rapidly, as in *Iguanodon*. At 8 cm. ($3\frac{1}{7}$ in.) from the distal end the width of the bone is 6 cm. ($2\frac{4}{11}$ in.); at 10 cm. (4 in.) the width is 5 cm. (2 in.), at 12 cm. ($4\frac{7}{10}$) it is 4 cm. ($1\frac{3}{5}$ in.). At 15 cm. (6 in.) from the distal end the bone is 3 cm. ($1\frac{1}{5}$ in.) from back to front and 3 cm. wide.

The posterior aspect of the bone is marked by a rounded median ridge (fig. 3, c), which becomes narrower and less elevated distally; two thirds of the bone lie on its fibular side, which is flattened and

compressed, and one third on the inner side, which is necessarily more oblique and rounded.

Since the head of the bone is nearly at right angles to the distal end, it necessarily happens that there is no appreciable increase in width as the bone extends proximally. But on the external surface the bone curves a little outward and forms a compressed area, convex from front to back, which terminates proximally in two small convex condylar surfaces (fig. 3, B). The internal aspect of the proximal surface is decayed, so that no account of it can be given.

The cnemial crest (fig. 3, A, *c*) was evidently developed on the Iguanodont plan; but its proximal portion has been sawn away.

The anterior outline of the bone, as preserved, is concave; the posterior outline is sigmoid (fig. 3, A). The posterior surface shows at 12 cm. ($4\frac{7}{10}$ in.) from the proximal end a large vascular perforation in the bone, which, as it rises proximally, becomes a groove (fig. 3, A).

As compared with *Iguanodon* this specimen differs chiefly in being more slender and in some details of conformation of the distal end. But although the differences are suggestive of generic distinction, the condition of preservation does not admit of the enunciation of generic characters. On the other hand the form closely approximates to *Hadrosaurus*, and is certainly intermediate between *Iguanodon* and that type *; and this combined with the characters of the femur indicate a divergence from *Iguanodon* in the same direction as in that bone, which justifies the association of the tibia, femur, and metatarsal bone. The metatarsal bone is too imperfect for description, but it differs in form from any similar bone that has been figured.

Discussion.

The President remarked upon the interest attaching to these latest known of the Dinosaurs.

Dr. Woodward referred to an Iguanodont vertebra in the British Museum which was dredged from the Dogger Bank. Possibly this was derived from the Maastricht beds, and Prof. Seeley might be able to associate it with the bones described in the paper.

The Author stated that many Iguanodont remains were found in the Crag and the Drift; but it would be unsafe to infer any possible relations to one another.

* It may be also compared with the tibia referred to *Megalosaurus* by Prof. Owen (Rept. Weald, part iii., 1856), but will be seen to be of distinct type.